ANSWERS: Types of Reactions

1)

Reagent	Formula of reagent / conditions	Type of reaction
A	H_2O/H^+	addition
B	PCl_5 / PCl_3 / $SOCl_2$	substitution
C	KOH (alc)	elimination

2) i) MnO_4^- / H^+ or $Cr_2O_7^{2-}$ / H^+
ii) purple → colourless, or orange → green
iii) 2-methylpropan-1-ol. Since it is a 1° alcohol it can be oxidised to a carboxylic acid / since the others are secondary or tertiary alcohols and can't be oxidised to a carboxylic acid.

3) i) Acid-base / neutralisation
ii) CO_2 gas is a product of the reaction and so bubbles of gas are given off.
iii) $CH_3CH_2CH_2COONa$

4) Chloroethane reacts with $KOH_{(aq)}$ to form an alcohol in a substitution reaction; Cl is replaced by OH.
$CH_3CH_2Cl \rightarrow CH_3CH_2OH$

Chloroethane reacts with $KOH_{(alc)}$ to form an alkene in an elimination reaction; H and Cl removed / HCl formed.
$CH_3CH_2Cl \rightarrow CH_2 = CH_2$

Chloroethane reacts with NH_3(alc) to form an amine in a substitution reaction; Cl is replaced by NH2
$CH_3CH_2Cl \rightarrow CH_3CH_2NH_2$

5) $CH_3 – CH = CH_2$
Elimination

6) a) i) Reaction One
Reactant A – H_2O / H^+ Type – addition
OR H_2O / acid
OR concentrated H_2SO_4 then H_2O
OR dilute / aq H_2SO_4

ii) Reaction Three
Reactant C – bromine / Br_2 Type – substitution

7) Addition – occurs in alkenes because they have double bonds. Ethene is an alkene so will undergo addition reactions. The chlorine (molecule) will add (across the double bond.)

$CH_2 = CH_2 + Cl_2 \rightarrow CH_2Cl – CH_2Cl$

Substitution occurs in alkanes (because they have single bonds). Ethane is an alkane, so will undergo substitution reactions. One hydrogen atom will be removed from the molecule and one chlorine atom will take its place. UV light is required for the process.

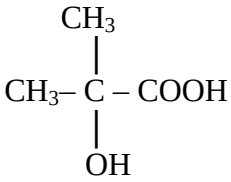
$CH_3 - CH_3 + Cl_2 \rightarrow CH_2Cl - CH_3 + HCl$

8) i) CH_3COOH
(accept ethanal, if its full structure is given)

ii) CH_3COONa or CH_3COO^-

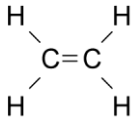
iii) $CH_3 - C(CH_3) = CH_2$

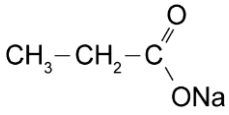
iv)



Alcohol reacts with $Cr_2O_7^{2-}$ / is oxidised to form carboxylic acid.
This must be a (carboxylic) acid because it reacts with sodium carbonate.

The tertiary OH group isn't oxidised by acidified dichromate/only the primary OH / OH on the end carbon is oxidised / reacts

9) a)  OR ethene elimination

b)  OR sodium propanoate acid-base

c) $CH_3-CH_2-CH_3$ OR propane addition

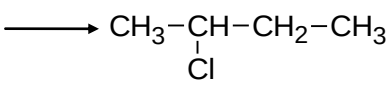
10) In both reactions, a colour change from purple to colourless will be seen as purple MnO_4^-/H^+ is reduced to Mn^{2+}.
(OR colour change from purple to brown precipitate if non-acidified MnO_4^-.)
Ethene will react to form a diol,
ethan-1,2-diol:

$$CH_2CH_2 \xrightarrow{MnO_4^-/H^+} CH_2(OH)CH_2(OH)$$

Ethanol will react to form a carboxylic acid, ethanoic acid:

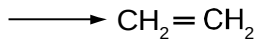
$$CH_3CH_2OH \xrightarrow{MnO_4^-/H^+} CH_3COOH$$

11) a)



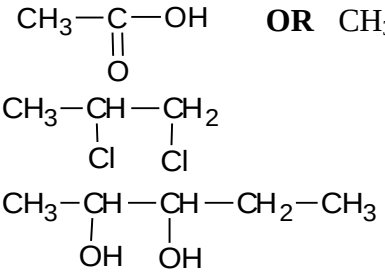
Addition involves a small molecule (HCl) joining onto adjacent carbon atoms of an unsaturated molecule. The double bond breaks / molecule becomes less unsaturated / becomes saturated.

b)



Elimination involves the removal of two substituents / groups / H & OH / water / on neighbouring C atoms in a molecule. A double bond forms / forms an alkene / the molecule becomes less saturated.

12)

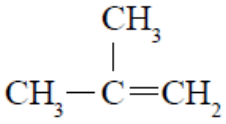


OR CH_3COOH **OR** CH_3CO_2H

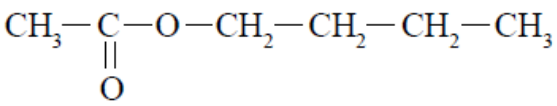
13) Conc. sulfuric acid / conc. H_2SO_4

14)a)

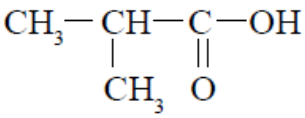
(i)



(ii)



(iii)



b) MnO_4^- / H^+ Purple to colourless.